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X-661-71-152
PREPRINT

NASA TM X- 65519

A LIMIT ON LINE EMISSION IN THE X-RAY BACKGROUND AT HIGH GALACTIC LATITUDES

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APRIL 1971



GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND

FACILITY FORM 602

N71-24960	(ACCESSION NUMBER)	(THRU)
6	(PAGES)	63
TMX-65519	(NASA CR OR TMX OR AD NUMBER)	29
		(CATEGORY)

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ABSTRACT

A rocket observation of the diffuse X-ray background at high galactic latitudes does not exhibit a statistically significant enhancement in the vicinity of 7 keV, implying a line intensity $\leq 0.06 \pm 0.04 \text{ (cm}^2 \text{ sec sr)}^{-1}$.

Recent data from rocket flights by the Naval Research Laboratory (Henry et al 1971; Shulman et al 1971) indicate line emission (~ 1 keV wide) in the X-ray background at about 6 to 7 keV. This line emission appears to be associated with high galactic latitudes as well as low galactic latitudes, thereby suggesting that a significant part of this effect is of extragalactic origin. The purpose of this letter is to point out that our rocket observations of the diffuse background are inconsistent with such an extragalactic line of the strength indicated by the NRL data.

The comparison data reported here were obtained during a rocket flight on March 3, 1969. The first portion of the flight was devoted to a search for iron line emission from Sco X-1 (Holt, Boldt, and

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The comparison data reported here were obtained during a rocket flight on March 3, 1969. The first portion of the flight was devoted to a search for iron line emission from Sco X-1 (Holt, Boldt, and

Serlemitsos, 1969). The remaining analyzed portion was a scan of about 1 degree per second along a great circle from $b \approx +40^\circ$ to an extended stop at the north galactic pole which provided the data for the results described here. Details of this measurement and conclusions about the background have been reported elsewhere (Boldt et al 1969). In summary, our proportional counter observations give a spectrum for the diffuse background intensity (I) over the band 2 - 20 keV as

$$\frac{dI}{dE} = 8.4 E^{-n} \text{ (cm}^2 \text{ sec sr keV)}^{-1} \quad (1)$$

where E is the photon energy in keV and $n = (1.35^{+0.07}_{-0.10})$. This spectral shape is in good agreement with $n = 1.4$ used by Henry et al (1971) to describe the continuum spectrum in the region of a few keV.

We consider separately the data obtained from three counters, designated A1, A2, and A3. An expression for the incident flux given by equation 1, for $n = 1.35$, was folded through the measured response function of each detector, and the predicted count profile for the pulse height analyzer was compared with the observed count profile. In order to obtain a nominal bin size of about 1 keV, comparable to the spectral resolution (FWHM) at 7 keV, we combined data into pulse height intervals that are 4 channels wide. For an expected count N_0 and an observed count $(\Delta N + N_0)$, we evaluated the quantity $\Delta N/N_0$ as a measure of the ratio of line to continuum intensity for each interval. The results of such an evaluation are shown in Figure 1.

Combining the results of the three counters we obtain $\frac{\Delta N}{N_0} \leq (0.10 \pm 0.06)$, for line emission at about 7 keV. Using equation 1, the continuum intensity at 7 keV is $0.61 \text{ (cm}^2\text{sec sr keV)}^{-1}$, so that these results imply a line intensity $\leq 0.06 \pm 0.04 \text{ (cm}^2\text{sec sr)}^{-1}$, an upper limit that is an order of magnitude smaller than the line intensity of $0.5 \text{ (cm}^2\text{sec sr)}^{-1}$ reported by Shulman et al (1971). We emphasize that our result pertains only to high galactic latitudes and leaves open the interesting possibility of intense line emission at about 7 keV that may be associated with the galactic disk (Ramaty et al 1971).

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FIGURE 1

$\Delta N/N_0$ as a function of pulse height analyzer channel is plotted separately for each of three counters, A1, A2, and A3. N_0 is the expected count for an incident flux $8.4 \text{ E}^{-1.35} (\text{cm}^2 \text{ sec sr keV})^{-1}$, and $(\Delta N + N_0)$ is the observed count. Indicated 4 channel intervals correspond to 1.10 keV for A1, 0.88 keV for A2 and 1.00 keV for A3. An arrow indicates the position expected for a line at 7 keV, for each of the counters. The diamonds show the standard statistical errors associated with the data.

